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PROGRESS IN SOIL AND WATER CONSERVATION RESEARCH

a quarterly report

Soil and Water Conservation Research Division
Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE
No. 13

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The Soil and Water Conservation Research Division works in cooperation with State Agricultural Experiment Station.

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Georgia

ADEQUATE SOIL MOISTURE IMPROVES QUALITY OF PEANUTS

G. N. Sparrow, R. L. Carter, and J. R. Stansell, Tifton.--The necessity for maintaining an adequate supply of available soil moisture from bloom to maturity for production of high quality peanuts was indicated in experiments with peanut irrigation at the Georgia Coastal Plain Experiment Station in 1956. The appearance of the plant seemed to be a dependable gage of the need for water.

In the experiments irrigations were started at bloom, unless the plants suffered severely from scarcity of moisture prior to that time. Four varieties of peanuts were involved in the studies. Runner peanuts were subjected to several levels of soil moisture. Four varieties were maintained in soil of high moisture content as opposed to moistures provided by rainfall alone.

TABLE 1.--Yield, value, and quality of Southeastern Runner 56-15 peanuts produced under various levels of soil moisture, Tifton, Ga., 1956

Irrigation treatment	Yield per acre	Market value per ton	Weight		
			Sound kernels	Hulls	Shrivels, etc.
	Pounds	*Dollars*	*Percent*	*Percent*	*Percent*
Not irrigated	1681	186.20	58	29	13
Irrigated at 0.8 atmosphere of soil moisture tension	2355	209.75	70	23	7
Irrigated at 0.3 atmosphere of soil moisture tension	2460	226.95	73	23	4
Irrigated on basis of plant appearing in need of water	2413	228.45	73	22	5

The soil in which the experiments were conducted is Tifton loamy sand. Peanuts were considered to be in effective bloom by June 27. Adequate moisture was provided by rain until late July, while August was relatively dry. Periods of moisture stress came in August. Runner peanuts showed that they were suffering for water at moisture stresses between the 0.3 and 0.8 atmosphere levels. Data obtained for Southeastern Runner 56-15 peanuts under four moisture regimes are given in table 1.

The varieties listed in table 2, when irrigated, were produced in soil moistures not exceeding 0.3 atmosphere of tension from bloom to maturity. The high market value of the Virginia Bunch G-2 variety under irrigation resulted from favorable percentages of fancy size and extra large kernels. Grading data and market value were supplied impartially by the Federal-State Inspection Service. Grading was later verified by sample analysis in the laboratory.

These data are preliminary, being based on the first year only of the study of peanut irrigation, but they do indicate that peanut irrigation in the Southeast may be a sound practice for crop insurance. The studies will be continued.

TABLE 2.--Yield data from 4 varieties of peanuts under conditions of adequate moisture supplied by irrigation and inadequate moisture from rainfall alone, Tifton, Ga., 1956

Variety and treatment	Yield per acre	Market value per ton	Weight		
			Sound kernels	Hulls	Shrivels, etc.
Southeastern Runner 56-15	*Pounds*	*Dollars*	*Percent*	*Percent*	*Percent*
Irrigated	2195	230.25	75	23	2
Not irrigated	1787	209.25	65	26	9
Dixie Spanish					
Irrigated	2151	239.25	75	22	3
Not irrigated	1684	192.25	70	23	7
Virginia Bunch 67					
Irrigated	1953	225.30	72	23	5
Not irrigated	1633	214.35	69	27	4
Virginia Bunch G-2					
Irrigated	2147	244.57	69	25	6
Not irrigated	1872	100.00	54	34	12

Alabama

IRRIGATION AND EARLY PLANTING INCREASE FALL GRAZING.

H. A. Weaver and O. L. Bennett, Thorsby--Irrigation increased the yields of rye, ryegrass, crimson clover, oats, rescue grass, and millet when plantings were made on August 15 rather than September 15. Yield data of dry forage of these crops grown with and without irrigation and planted on three dates are given in the accompanying Table. The advantages of irrigation and early planting were evident for all crops. Oats and rescue grass were practically crop failures without irrigation. Only millet produced a good crop when planted August 15 without irrigation, but considerable increase with it was obtained with irrigation.

The need for increasing the production of fall forage is especially critical in this area because of the scarcity of rain during the late summer and early fall. This makes it difficult to prepare land and obtain good stands of fall sown crops.

Total fall yields of four irrigation and unirrigated grazing crops for three planting dates, Thorsby, Ala.

Species	Yield of dry forage per acre					
	Irrigated			Unirrigated		
	D_1*	D_2*	D_3*	D_1*	D_2*	D_3*
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Rye-Rye Gr.-Crimson Cl.	3287	2581	2319	1429	1736	1578
Oats	2314	899	1158	361	257	481
Rescue Gr.	2930	651	389	37	205	0
Millet	5834	5341	640	3546	1571	62

*D_1 planted August 15 D_2 planted September 1 D_3 planted September 15

Texas

IRRIGATION TREATMENTS AFFECT WHEAT CHARACTERISTICS

M. E. Jensen, K. B. Porter, and W. H. Sletten, Bushland. --Laboratory analysis of winter wheat indicates irrigation water management affects milling and baking quality of winter wheat. Wheat samples from 6 irrigation treatments and 6 fertility treatments were analyzed for milling and baking properties. Consumptive use measurements were made on 3 nitrogen rates on each of the 6 moisture treatments. The accompanying table shows the correlation between the yield, straw-grain ratio, efficiency of water use, protein in wheat, and the baking score for the corresponding wheat samples. The table also gives the correlation between the efficiency of water use and the various milling and baking qualities.

From these data it appears that the baking score decreases as the yield increases, increases with the straw-grain ratio, and decreases as more wheat is produced for each inch of water used. The use of nitrogen fertilizer increased the protein content of the wheat, but in this test protein content of the wheat was not related to baking score.

Efficiency of water use expressed as bushels of wheat per acre-inch of water is inversely related to the straw-grain ratio, the peak and stability time from the Farinograph curve, loaf volume, and wheat ash.

These data were obtained from the 1956 wheat crop and represent only 1 year's data. Milling and baking quality will be checked again in 1957 and 1958, using the same variety.

Relationship between yield of winter wheat and baking score, straw-grain ratio and baking score, efficiency of water use and baking score, nitrogen fertilizer and protein in wheat, and efficiency of water use and milling and baking characteristics, Bushland, Tex., 1956

Relationship	r	Regression equation
Yield vs. baking score	-0.659**	y = 79.89 - 0.72x
Straw-grain ratio vs. baking score	0.762**	y = -41.82 + 58.57x
Efficiency of water use vs. baking score	-0.807**	y = 2.70 + 38.64x
Protein in wheat vs. baking score	0.326	y = -6.60 + 5.11x
Nitrogen fertilizer vs. wheat protein	0.755**	y = 11.32 + 0.012x
Efficiency of water use vs. straw-grain ratio	-0.631**	y = 2.16 - 0.63x
Efficiency of water use vs. wheat protein	-0.146	y = 12.66 - 0.44x
Efficiency of water use vs. nitrogen fertilizer	0.250	y = 0.07 + 49.49x
Efficiency of water use vs. peak (Farinograph)	-0.568*	y = 5.48 - 1.45x
Efficiency of water use vs. Stab. (Farinograph)	-0.797**	y = 9.00 - 3.66x
Efficiency of water use vs. MIT (Farinograph)	0.202	y = 35.42 + 24.10x
Efficiency of water use vs. loaf volume	-0.464*	y = 727.04 - 41.94x
Efficiency of water use vs. wheat ash	-0.508*	y = 1.1556 - .12x
Efficiency of water use vs. total flour	-0.282	y = 61.71 - 1.56x

n = 18 n-1 = 17 5% r = .456 1% r = .575

Nebraska

PREPLANT IRRIGATION RAISES CORN YIELD

Ralph E. Luebs, Lincoln. --The amount of available subsoil moisture at planting is a limiting factor in dryland corn production, particularly in the western area of the Corn Belt. Rainfall received in this area while the crop is growing is rarely of sufficient amount or of optimum distribution to produce satisfactory yields of corn.

In a 1956 experiment at the Agronomy Farm, Lincoln, certain plots were wet by sprinkler irrigation to a depth of over five feet prior to corn planting. Other plots had readily available moisture only in the surface eighteen inches at the beginning of the corn growing season.

Moisture in soil of irrigated and unirrigated plots at the beginning of the growing season and at silking time, Lincoln, Neb., 1956

Soil layer	Average soil moisture content*			
	No preplant irrigation		Preplant irrigation	
	Planting	Silking	Planting	Silking
Inches	*Percent*	*Percent*	*Percent*	*Percent*
0-6.....	21.1	8.4	22.5	10.8
6-12.....	23.1	13.6	24.4	15.9
12-24.....	20.1	16.9	25.6	19.7
24-36.....	17.5	16.4	23.7	20.5
36-48.....	16.6	15.6	23.0	21.9
48-60.....	16.1	15.2	22.8	22.7

*Wilting percentage 16.7; field capacity 25.8 percent.

Because of the severe moisture deficiency, only a relatively few corn plants in the nonirrigated plots produced silks. The average corn yield for 36 plots receiving a preplant irrigation was 76 bushels per acre while the average yield for the 36 nonirrigated plots was 2 bushels per acre, essentially a crop failure.

The rainfall measured at the plots between planting time and silking was 6.47 inches. Weather records show that this is about 1.5 inches below normal for this period. It is doubtful if normal precipitation would have appreciably changed the interpretation of these results.

A recommended dryland plant population of between 11,000 and 10,000 plants per acre was used. Based on soil moisture data, plant roots extended to a depth of 4 feet in the irrigated plots but did not reduce the soil moisture content to the wilting percentage.

Missouri

154-ACRE WATERSHED FURNISHES IRRIGATION WATER DURING DROUGHT

J. F. Thornton and V. C. Jamison, Columbia. --During the 5-year drought period, 1952 through 1956, runoff from a 154-acre mixed-cover watershed at McCredie was sufficient to irrigate about 10 acres of corn annually after satisfying the storage losses. The soil is Mexico silt loam, a claypan, classified as slowly permeable. Runoff was stored in a 16-acre reservoir from which evaporation and seepage losses were measured. Table 1

gives the rainfall and watershed yields by months during the 5-year period. The evaporation and seepage losses are given in table 2.

These data are the basis for the following observations:

1. The minimum water yield of 0.56 inch from the 154-acre watershed which occurred in 1954 lacked 140 acre-inches of taking care of the evaporation and seepage losses from the reservoir.

2. The average annual yield was 2.76 inches from the 154-acre watershed for the 5-year period. This would be sufficient to irrigate about 10 acres of corn after providing for evaporation and seepage losses from the reservoir.

3. The watershed yield depends on the intensity of the rain, the season of year, the cover, and soil moisture. In the winter when the ground is frozen, the yield from rain is very high. When the rainfall intensity exceeds about 0.30 inch per hour, runoff may start on dry, bare soil due to surface sealing and even sooner on wet soil. A 2.60-inch rain in April, 1952, produced 2.35 inches of runoff.

4. The average annual evaporation and seepage losses from the 16-acre reservoir were 50.26 inches for the 5-year period.

TABLE 1.--Runoff by months from the 16-acre reservoir watershed and monthly precipitation for the drought years of 1952 through 1956, McCredie, Mo.

Month	Runoff and precipitation									
	1952		1953		1954		1955		1956	
	Runoff	Precipitation	Runoff	Precipitation	Runoff	Precipitation	Runoff	Precipitation	Runoff	Precipitation
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
January..	0.61	1.10	0.07	1.42	0	0.71	0.67	2.01	0	0.38
February.	0.80	1.23	0.04	1.01	0	0.72	.85	3.06	0.01	1.17
March....	2.52	3.42	0.90	3.60	0.07	1.99	.12	1.26	0	0.37
April....	2.35	2.60	0.40	2.95	0.05	3.58	.31	3.05	0.12	2.49
May.....	0	2.15	1.04	3.74	0.03	3.62	.03	3.12	0.03	4.36
June.....	0	3.35	.01	3.50	0.02	2.45	.21	4.95	0	1.80
July.....	0	2.37	0.05	1.96	0	0.20	0.02	2.89	1.37	9.20
August...	0	4.78	0	2.14	0	5.33	0.02	2.66	0.05	2.78
September	0	1.26	0	2.38	0.01	1.93	.04	3.89	0	0.65
October..	0	0.21	0	2.72	0.32	4.72	0.45	4.52	0	1.22
November.	0.07	4.23	0.01	0.60	0.02	1.04	0.01	0.63	0.02	1.60
December.	0	1.43	0	0.71	0.04	1.52	0	0.16	0.06	2.84
Total..	6.35	* 28.13	2.52	* 26.73	0.56	* 27.81	2.73	* 32.20	1.66	* 28.86

* Mean annual precipitation: 39.01 inches

TABLE 2.--Evaporation and seepage by months from the 16-acre reservoir for the drought years of 1952 through 1956, McCredie, Mo.

Month	Evaporation and seepage*				
	1952	1953	1954	1955	1956
	Inches	*Inches*	*Inches*	*Inches*	*Inches*
January	1.12	1.19	0.92	1.26	1.33
February	1.69	2.09	1.64	1.15	1.94
March	2.17	2.60	2.81	2.95	3.57
April	4.19	3.70	4.33	3.98	4.14
May	4.63	5.55	5.02	5.15	4.80
June	6.89	7.34	6.23	5.29	6.17
July	8.05	7.17	9.61	7.01	6.19
August	5.49	7.06	5.94	7.75	7.09
September	5.47	6.91	6.09	5.58	7.42
October	4.94	3.46	3.72	4.44	4.64
November	2.87	3.02	2.00	3.23	2.96
December	1.11	2.75	1.13	1.22	1.14
Total	48.62	52.84	49.44	49.01	51.39

*Mean annual precipitation: 39.01 inches

Nevada

WATER USE BY ALFALFA TO BE STUDIED

Victor I. Myers and Rhys Tovey, Reno, Nevada.--An extensive lysimeter tank study is being undertaken to evaluate a number of variables relating to the consumptive use of plants and the need for irrigation under high water table conditions. This study is based upon preliminary results reported in Quarterly Progress Report No. 11.

The tanks will be filled with soils of coarse, medium, and fine texture. Water tables will be maintained at depths of 2, 4, and 8 feet. One set of tanks at the 3 water table depths will not be irrigated in order to determine if moisture, adequate for supplying evapotranspiration needs of alfalfa, can be obtained from capillary movement from the water table.

Most of the tanks will be seeded to alfalfa. One set, however, will be maintained free of vegetation to provide data on the evaporation of moisture from a bare soil surface.

Additional tanks are included in which the soil moisture will not be permitted to exceed field capacity. Data from these tanks are to be compared with those from the tanks with the high water table.

Soil water movement data will be collected from tensiometer banks placed in the tanks. Extensive weather and evaporation data will also be collected at the research site.

Colorado

GRAVEL PACKS FOR IRRIGATION WELLS TO BE STUDIED

Gordon Kruse, Fort Collins.--Studies to determine proper selection of gravel packs for irrigation wells have been resumed at Colorado State University. Previous studies resulted in disagreement on the effect of pack and aquifer uniformity on suitable gravel pack design for irrigation wells. The pack and aquifer materials used in the present study will have uniformity coefficients ranging from 1.1 to 5.0. Pack and aquifer ratios will be varied from 1.6 to 7.9.

A wedge-shaped plexiglass model representing a section of an irrigation well will be used in the study. The model will be filled with various combinations of the pack and aquifer materials. Water from a constant head tank will then flow radially through the model, simulating actual well conditions. The suitability of various pack and aquifer combinations will be judged according to the piezometric head loss through the gravel pack and the amount of aquifer material washed into the gravel pack.

DRAINAGE

California

WELL SHOWS PROMISE FOR DRAINAGE IN SAN LUIS SCD

Leonard Schiff, Bakersfield.--The continuous operation for 24 days of a 190-foot experimental drainage well in the San Luis Soil Conservation District has lowered the water table over an area of about 1 square mile, and the zone of influence is still increasing. The water table in the area was within 2 to 3 feet of the soil surface at the beginning of the test run.

The test well is located near an irrigation canal on the south boundary of the District. Fortunately, preliminary tests show no seepage from the canal into the zone of influence of the well. Seepage does move, however, from the slopes above the canal and into the District. Some of the water pumped is supplied by this seepage, and thus adversely influences the effectiveness of the test well.

Sixteen shallow observation wells have been installed for use in measuring hydraulic gradients, changes in water table depths, and the extent of seepage from the higher lands above the canal. Four of these wells are located along each of the 4 cardinal directions 1/4 mile apart, starting 1/4 mile from the test well.

Soils of the test area are characterized by stratified lenses extending to a depth of about 10 feet. Permeability of the soil to a depth of about 4 feet is generally low. Water is found to be under pressure below 4 feet depth in some of the observation wells. This pressure has been relieved by the pumping well.

If drainage wells are found to be feasible, a series of them located along the upper boundary of the District may prove desirable. Seepage from above the District would be reduced and additional drainage wells located at lower levels in the District could be operated more effectively.

The feasibility of drainage by wells is enhanced by the fact that the pumped water, at least of this test well, is of good quality and could be used for irrigation locally or sold to other water users.

The San Luis SCD and the San Luis Canal Company are cooperating to supply materials and are operating the well. The SCS is collecting the data and with the ARS are cooperating to locate all installations and analyze and interpret the data. A report is to be prepared on results shortly after the test is concluded.

Florida

FLOODING DAMAGE INCREASED BY DISEASE

John C. Stephens, Ft. Lauderdale. --Tests on submersion damage to crops were continued. Preliminary work in past years has indicated (1) that several of the truck crops grown in this area could withstand up to 36 hours submersion with only slight injury in soils with rapid internal drainage and (2) that differences in soil microbiological populations probably have considerable effect on plant survival.

The above observations were further borne out by additional studies this past year in which Black Valentine bush beans, grown in the twelve 0.001-acre lysimeter tanks, were subjected to surface flooding. Two separate crops were tested. In each case, flooding was continued for 12-, 24-, 36-, 48-, and 60-hour intervals. The water tables were then drawn down and held at a depth of 24 inches and the plants allowed to reach maturity at which time the yield weight, quality, and degree of damage were evaluated.

The first crop, planted in late October, flooded the third week in November when the plants were in the early bloom stage, and harvested in early January, withstood flooding exceptionally well except in tanks flooded more than 36 hours. The average weight, in grams, of marketable beans obtained per plant was: for the (unflooded) check plots - 26; for those submersed 12 hours - 45; for 24 hours - 36; for 36 hours - 41; for 48 hours - 4; and for 60 hours - 4. These beans were flooded during a relatively cool period and rainy, cloudy weather occurred during and for several days after submersion.

In contrast, the second crop, planted in late February, flooded the first week in April when the plants were in the late bloom, and early pin stage, and harvested in late April, suffered severe injury. The average weight, in grams, of marketable beans obtained per plant was: check plots - 12; for those submersed 12 hours - 5, for 24 hours - 6; for 36, 48, and 60 hours - 0. Examination of the plant roots revealed that nematodes had invaded the soil in most of the lysimeter tanks. It appears significant that yields from the check plots were reduced to about one-half those of the first test and that the added stress of flooding for only 12 hours cut the yield from the crop in infested soil to about the same as produced by the 48- and 60-hour flooding period in the first test.

EROSION AND RUNOFF CONTROL

Wisconsin

CHEMICAL PASTURE RENOVATION REDUCES EROSION AND RUNOFF

Robert E. Taylor, LaCrosse. --Chemical renovation as compared with mechanical renovation reduced runoff and soil losses and improved the stand of alfalfa in experiments at the LaCrosse Experiment Station in 1955 and 1956. Furthermore, chemical renovation permitted a 50 percent reduction in tillage operations. The chemical treatment used consisted of spraying the old pasture sward in late August or early September with a mixture of 10 pounds per acre of Dalapon and 1 pound per acre of 2-4, D. The pasture area was worked twice with a large field cultivator - once, two weeks after spraying in the fall and, again, in the spring before seeding. Mechanical renovation required three or more workings in the fall and once before spring seeding.

Soil and water losses were slightly higher from mechanical renovation than from chemical renovation during the seeding years. Data in the accompanying table show that in the two-year period, 1955 and 1956, average soil losses were about 50 percent lower and runoff was 14 percent lower for the chemical renovation.

Runoff and soil losses from pasture plots renovated by chemical and mechanical methods, LaCrosse, Wis., 1955-56

Seeding year	Runoff and soil loss			
	Chemical renovation		Mechanical renovation	
	Runoff	Soil loss per acre	Runoff	Soil loss per acre
	Inches	*Tons*	*Inches*	*Tons*
1955	0.65	0.37	1.04	0.80
1956	0.67	0.16	0.48	0.18
Average	0.66	0.26	0.76	0.49

There was very little difference in botanical composition during the seeding year. Stand counts indicated that legumes, grasses, and weeds were present in about the same quantity. The weed population for the seeding year was quite high for both treatments, but these were mainly annuals such as shepherds-purse and lambsquarter.

Plant separations from first-year pasture show that alfalfa is about 10 percent more abundant in the chemical renovation. The high percentage of weeds in the third crop was due to dry weather.

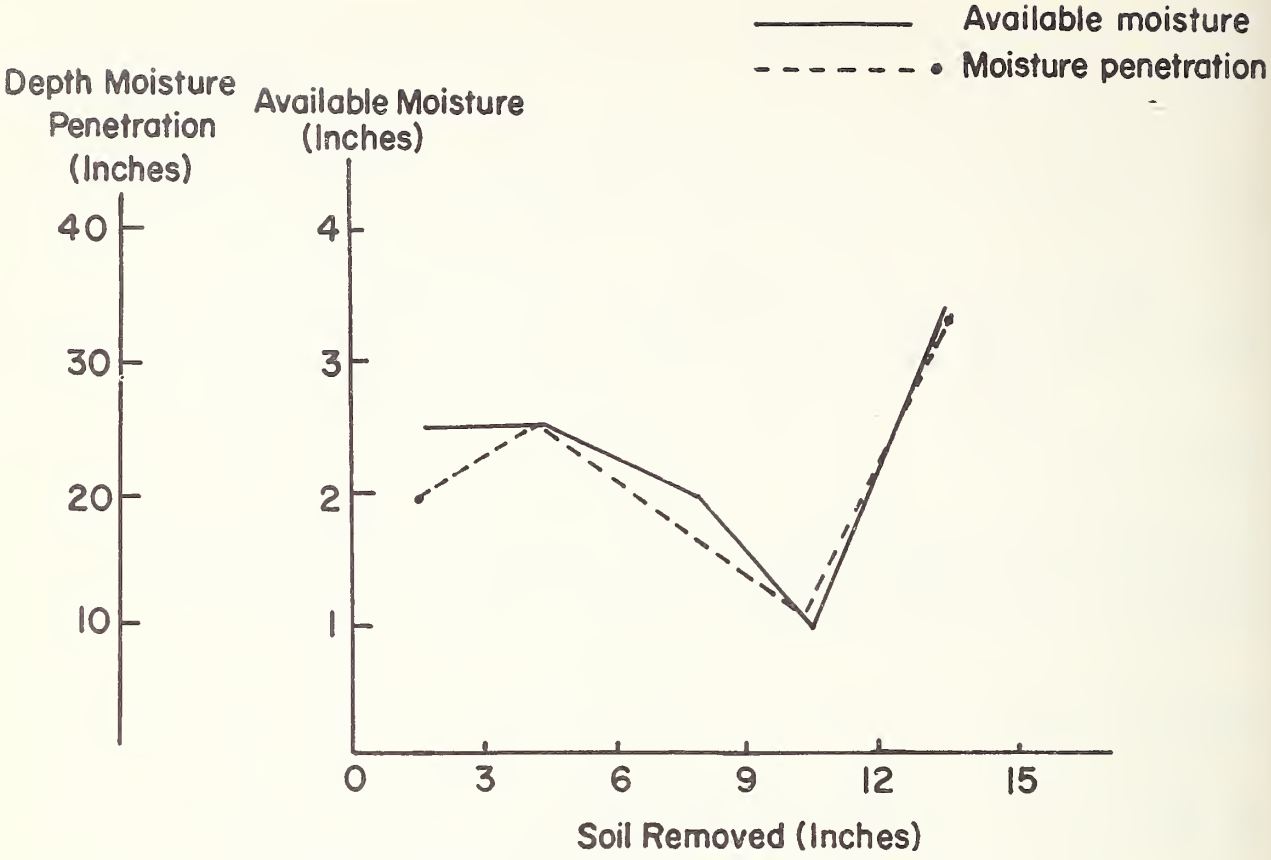
At the present time, exploratory studies are being conducted to determine whether or not the amount of Dalapon can be reduced so that the cost of the chemical treatment can be lowered.

Colorado

SOIL REMOVAL AFFECTS MOISTURE STORAGE DURING FALLOW

B. W. Greb, Akron.--Periodic observations and measurements showed wide differences in moisture penetration and storage on different soil surfaces exposed by removal of various amounts of surface soil. These conclusions come from the surface soil removal study described in Quarterly Progress Report No. 9. Soil removals of 6-9 inches and 9-12 inches were particularly resistant to wetting. The surface soil of these two depths consists of well aggregated silty clay loam nodules, while the 0-3 inches and 3-6 inches layers consist more of a mellow silt loam. The deepest cut of 12-15 inches into raw lime layers showed surprising ability to take water despite a tendency for the soil to slack somewhat during heavy rain showers. The trend described above was first noted after a rain June 17 and was consistent for each rain during the remainder of the fallow season.

The amount of soil moisture stored in the fallowed plots was generally low for the season as drought conditions prevailed during most of the season. Only a total of 10.9 inches of precipitation was received during January-September 1956. Most of the precipitation was received in 5 heavy storms between July 17 and August 16.



Soil moisture conditions on soil removal plots September 17, 1956, Akron, Colo.

Texas

SOIL AND WATER LOSSES REDUCED BY CERTAIN CROP SEQUENCES

R. M. Smith, Temple.--High runoff and erosion losses were recorded during March and April 1957 on 2 field-scale plots that have been in row crops continuously since 1951 as compared to plots previously in close growing crops. Losses were negligible on plots in oats, sweetclover or fescue-sweet clover. Data are summarized in the accompanying table.

Rainfall during March and April 1957 was heavier than for several years. The total for March was 5.6 inches compared to the longtime average of 2.1 inches, and for April the total was 9.0 inches, with a normal of 4.0 inches. These months account for all runoff losses to date in 1957 except for small losses on May 2 and June 1.

It is interesting that soil losses were distinctly less from corn following close growing crops than from corn following corn. Evidently there was a carryover effect from the preceding broadcast crops. Since all land preparation was by subsurface or trash-mulch methods the residues from the broadcast crops had a chance to influence erosion during the year of corn production. Runoff was slightly lower for corn following oats-sweetclover, and especially following grass-sweetclover. However, the main effect seems to be erosion reduction.

The slopes on different plots varied from 1.85 to 3.01 percent. In order to equalize the slope influence on erosion, all values for erosion were converted to equivalent losses on average, 2.37 percent, slopes. The conversion was based on erosion increase, as the

1.4 power of slopé. On this basis, soil loss per inch of runoff averaged 2.9 tons for corn following corn; 0.9 tons for corn following oats-sweetclover; and 1.2 tons for corn following grass-sweetclover.

The reduced soil loss or increased erosion resistance following broadcast crops may be of considerable importance. Carryover effects of this kind were not noted during the early years of runoff and erosion gaging at this location. Subsurface tillage methods now being used may account for the difference. Bedding and rebedding appears to leave residues at or near the surface, similar to subsurface plowing, but deep turning of the soil, or flat breaking, may eliminate most of the erosion control value of straw or stubble or other residues from broadcast crops in the Blackland.

Soil and water losses from field-scale plots from January 1 through June 30, Temple, Texas. 1957

Plot	Slope	Runoff and soil loss			
		Runoff	Soil loss per acre	Soil loss converted to 2.37 percent slope	
				per acre	per inch runoff
	Percent	*Inches*	*Tons*	*Tons*	*Tons*
			Corn following corn		
0-1	2.31	2.7	9.8	10.2	3.8
P-2	2.31	2.9	5.6	5.8	2.0
Average	2.31	2.8	7.7	8.0	2.9
			Corn following oats with sweetclover		
0-2	1.85	2.5	1.8	2.5	1.0
P-1	2.31	3.0	3.6	2.5	0.8
Average	2.08	2.7	2.7	2.5	0.9
			Corn following grass-sweetclover		
0-5	2.31	2.2	2.0	2.1	1.0
P-6	3.01	2.1	4.3	3.1	1.5
Average	2.66	2.1	3.1	2.6	1.2
			Oats-sweetclover		
0-6 & P-5	2.2	0.04	trace	--	--
			Grass-sweetclover		
0-3, 0-4 P-3 & P-4	2.49	0.09	trace	--	--

SOIL FERTILITY

Colorado

NITROGEN BOOSTS GRASS YIELDS ON DRYLANDS

B. W. Greb, Akron.--A single test plot with ammonium sulfate in 1955 on Blue grama at the station produced a yield of 1,940 pounds dry forage as compared with 820

pounds dry forage on an unfertilized plot. The protein content of Blue grama was increased from 10.5 percent to 14 percent. The plot was fertilized early in April 1955 and received about 8 inches of precipitation during May and June and the clippings were taken July 5.

With this favorable indicator for nitrogen response, 37 pounds of N per acre as ammonium sulfate was broadcast on April 12, 1956, on various grass plots previously established on the station in 1942. Some of the original species were still relatively pure, while others showed considerable cross plot contamination. There was no effective precipitation received until July 17 after which a total of 6 inches of rain was received during 5 storms in the period ending August 16.

Yield of grasses as affected by nitrogen, Akron, Colo., 1956

Species	Grass yield per acre		
	No N added	37 lbs/A N	Increase from N
	Pounds	*Pounds*	*Pounds*
Turkestan bluestem	1,110	1,770	660
Caucasian bluestem	1,470	2,720	1,250
Side-oats grama	680	1,190	510
Blue grama (a)	720	1,150	470
Blue grama (b)	300	710	410
Weeping lovegrass	380	760	380
Sand lovegrass	770	1,720	950
Switch	450	1,230	690
Prairie dropseed	540	1,500	960
Alkali sacaton	740	1,610	870
Sand dropseed	1,000	1,970	970

Results

1. Although moisture conditions were unfavorable, a fairly good response was obtained from most of the warm season species. The response was reflected in all parts of the plant and particularly well in volume of grass heads.

2. The cool season grass species did not actively grow at any time during the season, with or without nitrogen fertilization. The fertilizer was consumed, however, by warm season weeds and grasses.

3. Active growth by the warm species was restricted to a period between August 1 and progressed until September 15 when soil moisture was depleted.

4. Color responses were noted on August 10 and actual growth differences were detected on August 25.

North Dakota

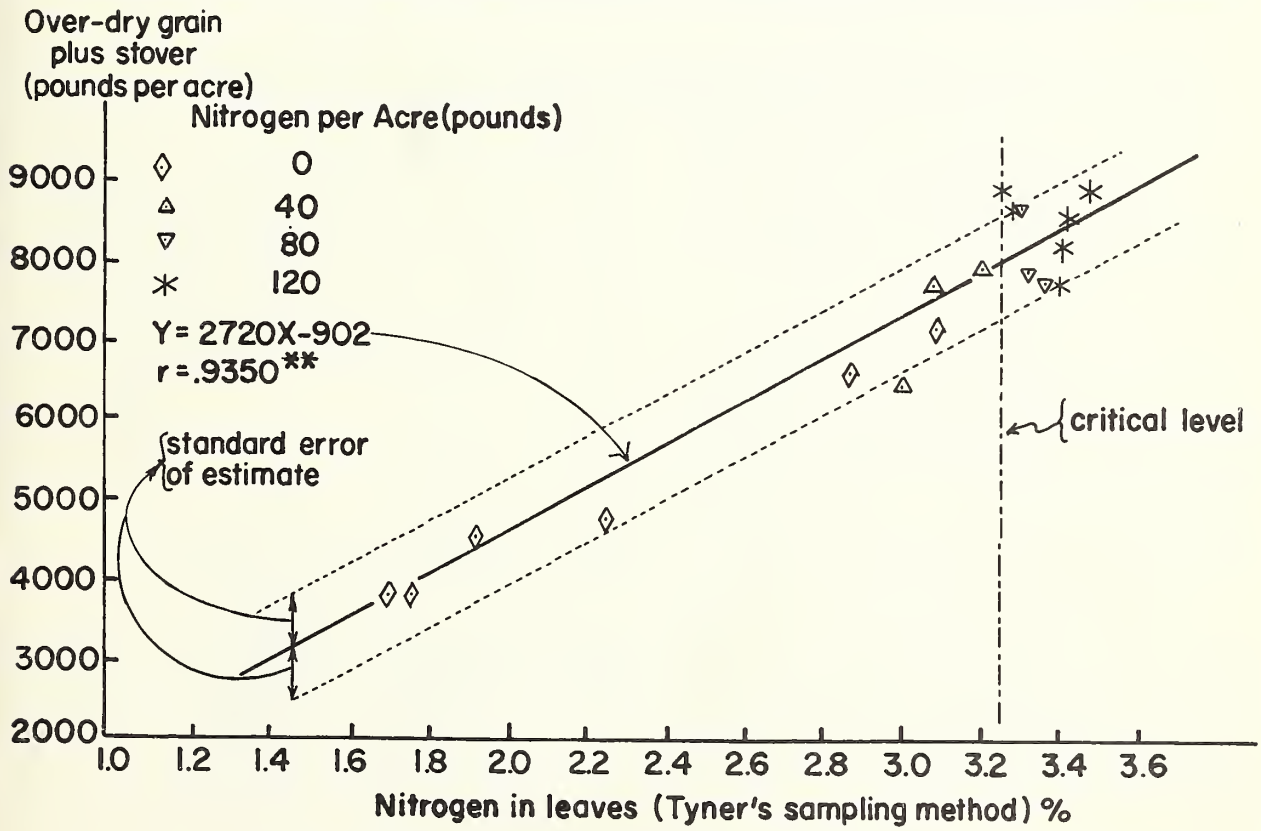
CORN YIELD AND NUTRIENT CONTENT RELATED UNDER IRRIGATION

G. A. Reichman, D. L. Grunes, C. W. Carlson and J. Alessi, Mandan. --The relationships between the yields and the nitrogen and phosphorus contents of the harvested plant parts have been determined for corn grown under two irrigated rotations on the Deep River Development Farm, North Dakota, during the years 1953-56. The nitrogen and phosphorus concentrations of the second leaf below the upper ear, sampled at the time the corn was pollinating (Tyner's method), was also compared to the yields for the same years. One rotation consisted of barley, corn, and potatoes; while the second rotation consisted of barley, 3 years of alfalfa, corn, and potatoes. The results are as follows:

The total nitrogen content of the harvested plant parts (ears plus stalks), and in most cases nitrogen concentrations, were increased by the application of nitrogen to the soil. These responses were greater when no legume was included in the rotation. The total phosphorus content is very closely related to the nitrogen content in both the grain and the grain plus straw. For both the corn grain, and the grain plus stover, the total uptake of both nitrogen and phosphorus was highly correlated with yields.

Leaves sampled according to the method proposed by Tyner indicate that the critical level* for nitrogen varied between 2.70 and 3.25 percent during the four years. The comparable values for phosphorus ranged from 0.274 to 0.325 percent. The critical nitrogen level for 1954 is shown on the accompanying graph for grain plus stover. The

*Critical level is the lowest nutrient that can be associated with a maximum yield. An increase in nutrient content above the critical level will not result in a yield increase.



Dry matter production of corn in a non-legume rotation as affected by the nitrogen content of leaves sampled at pollination time, Mandan, N. D., 1954. (All plots received 150 pounds of P_2O_5 per acre in 1953.)

nitrogen concentration of these leaves was generally increased by the addition of nitrogen fertilizer to the soil. For those plots treated with nitrogen, the phosphorus content was increased by the use of phosphorus fertilizer.

Both the nitrogen and phosphorus contents of leaves sampled according to the method of Tyner were significantly correlated with the yields. The relationship between the nitrogen content of these leaves and the dry matter production for 1954 is shown on the accompanying graph. The phosphorus contents were also found to be dependent upon the nitrogen contents.

Nebraska

SANDY LAND RESPONDS TO LEGUMES, LIME, AND PHOSPHATE

F. L. Duley, Lincoln. --Work on sandy land at the Pierce Farm in northeastern Nebraska showed that the yield of corn was greatly affected by the legume crop which preceded it. The protein content was also considerably higher, particularly with legumes like vetch and sweetclover which fix more nitrogen and provide a higher nitrate content in the soil for the oncoming crop. The total yield of protein per acre was over three times as high on sweetclover land where lime and phosphate had been used as where no legume was grown. The protein produced per acre on treated sweetclover land was five times as high as on the untreated soil where no legume was grown. The advantages of combining good soil treatments with legumes is thus shown to have a very great influence on the amount of feed units produced. On the untreated land the protein percentage with four of the legumes did not differ greatly from the land having no legume. The data are tabulated in the accompanying table.

Yield and protein content of corn, and amount of protein produced on sandy land receiving different soil treatments. Mean of 2 years results, Pierce Farm, Neb.

Legume	Corn		
	Protein	Yield per acre	Protein prod./acre
	Percent	*Bushels*	*Pounds*
	Lime and phosphate treatment		
Vetch	7.87	55.5	243
Sweetclover	8.68	65.7	321
Annual sweetclover	6.95	54.4	212
Lespedeza	6.62	41.2	154
Partridge pea	6.68	41.4	154
None	6.20	27.6	95
	No treatment		
Vetch	7.76	44.7	195
Sweetclover	6.68	31.0	117
Annual sweetclover	6.41	20.8	72
Lespedeza	6.41	25.6	91
Partridge pea	6.46	29.2	105
None	6.49	17.5	62

Puerto Rico

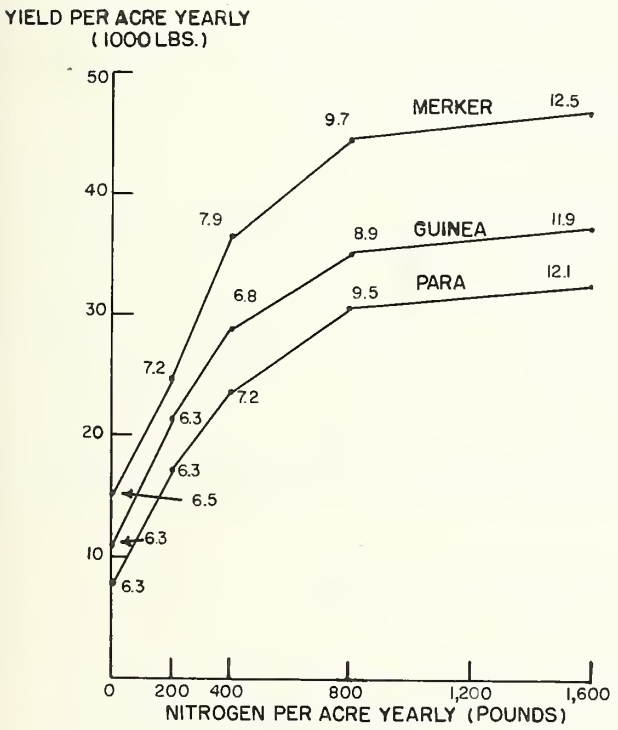
HIGH LEVELS OF NITROGEN BENEFIT TROPICAL GRASSES

Jose Vincente-Chandler, Rio Piedras.--Merker, Guinea and Para grass growing on a red clay soil with about 85 inches of annual rainfall responded strongly to nitrogen applications up to 800 pounds per acre yearly.

The deep, red, acid Fajardo clay was limed to pH 6.5, and 400 pounds of P_2O_5 and 600 pounds of K_2O were applied per acre to all plots. The grasses were cut every 60 days and one-sixth of the total annual application of nitrogen was applied in the form of ammonium sulphate.

The accompanying figure shows that all 3 grasses responded strongly in yield to nitrogen application up to 800 pounds per acre yearly. With all grasses, yields were about tripled by this treatment. This figure also shows that the protein content of the grasses increased with nitrogen fertilization up to the maximum level tested. The protein content of the grasses was about doubled by the application of 1,600 pounds of nitrogen per acre yearly.

At the 800-pound level of nitrogen Merker grass produced about 115 tons of green forage per acre yearly, Guinea grass about 75 tons, and Para grass about 70 tons of green forage per acre yearly.



Effect of nitrogen on dry matter yield and protein content of Merker, Guinea, and Para grass over a one-year period. Protein content is indicated in percent for each level of treatment. Lime, phosphorus, and potassium were supplied in abundance to all plots, Rio Piedras, P. R.

Puerto Rico

THREE CROPS OF CORN PRODUCED 172 BUSHELS IN 11 MONTHS

Jose Vincente-Chandler, Rio Piedras.--Since level, irrigated lands of the semiarid South Coast of Puerto Rico looked favorable for the commercial production of corn on the Island, an experiment was conducted under typical conditions to determine the effect of plant population, nitrogen fertilization, and season of the year on corn yields in this area.

Using a single-ear variety (Mayorbela) three crops harvested over an 11-month period, produced a total of 172 bushels per acre with the best treatments. Yields should easily exceed 200 bushels per acre yearly if adapted hybrids were available.

Season of the year had a marked effect on yields. The July planting with optimum plant population and fertilization produced 38 bushels per acre, the October planting 44 bushels, while the February planting produced 90 bushels per acre. A marked response to the application of 50 pounds of nitrogen per acre was evidenced on this very fertile soil. Yields also increased with plant population up to 22,000 plants per acre.

Maryland

TILLAGE METHODS AFFECT SOIL STRUCTURE

C. S. Britt and C. S. Slater, Beltsville.--Different methods of tillage and residue placements show different rates of structural deterioration in corn plots 2 and 3 years after sod.

Corn was grown annually with a winter cover crop of rye and vetch. Tillage variations include plowing, plow-depth tillage with sweeps and with a mulch-till "once-over" planter. Residues are chopped and disked and either turned under or left on the surface.

Structural conditions were determined by water-stability analysis of soil samples taken in March. The results are given in the accompanying Table. The figures for annual depreciation indicate a slight advantage in soil maintenance for residues left on the surface. The mulch-till planter, which stirs the soil less than either plow or sweeps, shows the lowest rate of annual structural deterioration.

Stability in water of aggregates from corn plots with different tillage treatments, Beltsville, Md.

Aggregate stability	Water stable aggregates				
	Residues left on surface			Residues plowed under	
	Mulch-till planter[1]	Sweeps[1]	Plow*[2]	Plow[2]	Plow[1]
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
Water-stability in plots.....	55.7	48.8	40.0	34.9	45.2
Water-stability of sod in plot borders.....	65.2	65.2	65.2	65.2	65.2
Depreciation from sod.....	9.5	16.4	25.2	30.3	20.0
Annual depreciation.....	4.8	8.2	8.4	10.1	10.0

[1] 2 years in corn
[2] 3 years in corn
*Crop residues removed during disking and plowing operations and then returned to plots.

Maryland

SOIL STRUCTURE IS PROTECTED BY WINTER COVER

R. V. D. Broach and C. S. Slater, Beltsville.--A rye cover crop fall-seeded on clean plowed ground had a measurable effect in preventing a loss of soil structure stability during the winter months. The rye was drilled with a 7-inch row spacing and reached a height of about 5 inches before cold weather retarded growth. Drill skips in the field provided bare check plots.

Paired samples from spots generally 2 feet or less apart were taken from cropped and bare areas in March. Ten locations were sampled. The stability of the soil aggregates against disintegration in water was measured and the results are given in the accompanying table.

There was a marked advantage in favor of the rye-covered areas. These data mean that a winter cover crop, like early fall planted rye, furnishes enough protection to pre-

vent much of the structural damage which often occurs during winter by repeated freezing and thawing.

Water stability analyses of paired soil samples under fall planted rye and from bare areas, Beltsville, Md., 1956

Field area	Water stability of soil aggregates		
	Rye cover	Bare area	Difference
	Percent	*Percent*	*Percent*
1	67.0	46.4	20.6
2	44.0	42.3	1.7
3	74.8	44.9	29.9
4	70.6	53.7	16.9
5	50.8	30.1	20.7
6	67.8	29.7	38.1
7	46.5	28.7	17.8
8	66.8	38.6	28.2
9	63.8	57.7	6.1
10	56.2	30.5	25.7
Mean	60.8	40.3	20.5

CROPPING SYSTEMS

Ohio

MANAGEMENT INCREASES SOIL ORGANIC MATTER ON WATERSHEDS

F. R. Dreibelbis and J. L. McGuiness, Coshocton.--Data from 16 small watersheds show that good conservation practices have markedly increased soil organic matter.

Organic matter content of soils on 16 small watersheds was determined in April of 1942. Some of these watersheds received poor management practices, for example, sloping row and low fertility, while on others the latest conservation practices were used. Organic matter content was again determined in October of 1956. The data from the 1956 samples are compared with those of 1942 in the accompanying table.

Average organic matter content of soils on 16 small watersheds, Cochocton Research Station, Ohio, 1942 and 1956

Year	Soil organic matter content				
	Four-year rotation (corn, wheat, meadow, meadow)			Pasture and Meadow	
	Improved practice (5 replicates)	Poor practice (4 replicates)	Mulch culture (4 replicates)	Improved (2 replicates)	Poor (single)
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
1942	2.19	2.31	1.94	2.39	2.31
1956	2.34	2.23	2.62	3.08	2.80
Gain	0.15	-0.08	0.68	0.69	0.49

The average gain in percent organic matter on the improved-practice area was 0.15, while on the mulched areas the increase in percentage was 0.68 or about 4 times as much. On the poor-practice areas percent organic matter dropped 0.08. The differences shown are statistically significant. Percent organic matter in the soil on the pasture and meadow watersheds increased an average of 0.69 on the improved watershed, and 0.49 on the poor practice area.

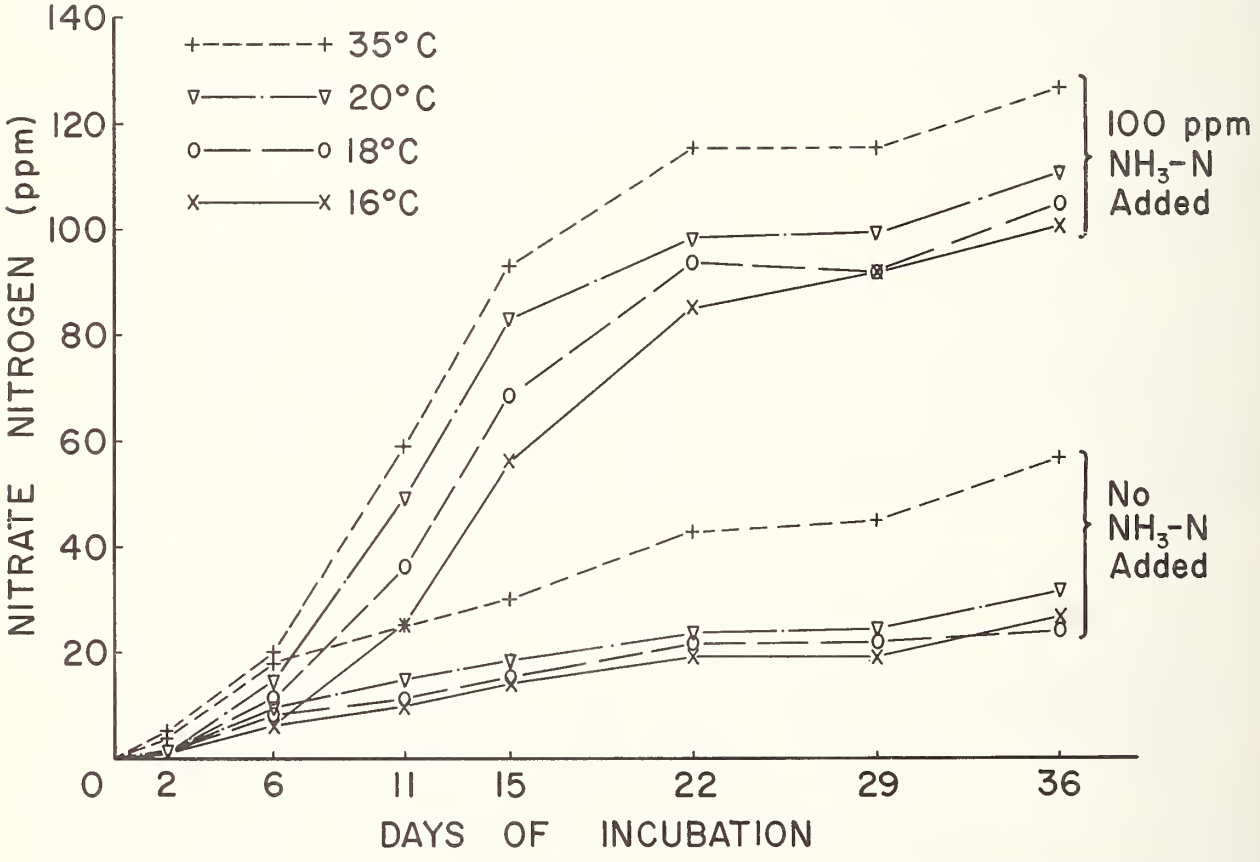
The soil organic matter level under continuous grass is significantly higher than under rotation. Apparently, the plowing and fitting operations associated with rotations tend to encourage oxidation of the accumulation built up under meadow. The mulch treatment seems to be as effective as continuous grass, but part of this effect may be due to the very low starting level (1.94 in 1942). The mulch treatment is still more effective in increasing soil organic matter than the other rotation treatments.

RESIDUE MANAGEMENT

Iowa

NITRIFICATION MEASURED AT LOW SOIL TEMPERATURE

D. T. Parker, Ames.--Laboratory studies have shown that nitrification is not critically influenced by soil temperature differences such as those which occur under mulch tillage as compared to clean tillage.



Nitrate nitrogen produced in Webster silt loam at different incubation temperatures with and without ammonia nitrogen, Ames, Ia.

Temperatures of mulched soils may differ from those of bare soils by as much as 10° F. early in the growing season when soil temperatures are below 70° F. In this study attention was given to temperatures between 61° and 68° F. (16° and 20° C.). As shown in the accompanying figure, nitrate produced in a Webster silt loam accumulated most rapidly in the interval between 1 and 3 weeks. There was an appreciable difference at this time between the amount of nitrate produced at the different temperatures. However, after 5 weeks, when nitrate accumulation had leveled off, there was little difference in the total amount of nitrate produced. The ammonia supply became limiting to nitrification after 3 weeks. Production of ammonia from residual soil organic matter contributed to the higher production of nitrate at the higher temperatures. Other soils gave similar results throughout.

Conversion of the values obtained to the basis of an acre plow layer shows that upon addition of 200 pounds per acre of ammonia nitrogen to a Webster soil, 150 pounds would be converted to nitrate nitrogen after 5 weeks at a temperature of 61° F. (16° C.). Corn plants take from an acre of soil in their first 5 weeks of growth less than 10 pounds of nitrogen. Thus, nitrification as influenced by temperature is not critical to the growth of corn under mulch tillage.

The effect of mulch tillage upon other factors that influence nitrification should be investigated.

Wisconsin

MULCH REDUCES EROSION FROM GRAIN FOLLOWING CORN

Orville E. Hays, LaCrosse. --Measurements at the LaCrosse Soil Conservation Experiment Station show that as an average for a 10-year period, spring grain land has lost twice as much runoff and two and one-half times as much soil as land planted to corn following hay. Both treatments were fall-plowed.

An experiment was initiated in 1957 to develop cultural treatments that will effectively reduce soil losses from spring grain land. The treatments under measurement are: (1) corn stover removed, fall-plowed; (2) corn stover removed, seedbed prepared with a field cultivator; and (3) corn stover chopped and returned to soil surface, seedbed prepared with a field cultivator. The treatments are in 4 replicates located on a 16 percent slope.

After seedbed preparation the plots were fertilized and seeded uniformly to spring grain. Data for 3 storms causing runoff in May 1957 are given in table 1. These data are by no means conclusive, but they do indicate a trend in effect of treatments.

TABLE 1.--Effect of cultural treatment following corn on runoff and soil loss from spring grain land, LaCrosse, Wis., 1957

Treatment	Runoff	Soil loss per acre
	Inches	*Tons*
Corn stover removed, fall-plowed	0.40	3.13
Corn stover removed, field cultivator	0.05	0.06
Corn stover mulch, field cultivator	0.02	0.02

All plots were in corn in 1956. The treatments, in 3 replicates, were: (1) plowed hay (standard); (2) 20-inch bands of hay between corn rows, killed with herbicides (dead); (3) 20-inch bands of hay between corn rows, hay clipped to maintain vegetative height between 2 and 6 inches (clipped); and (4) 20-inch bands of hay between corn rows, hay not clipped (unmowed). All treatments described above on grain were represented on each of the above treatments on corn. It was, therefore, possible to determine the effect of past treatment. The runoff and soil loss data as affected by treatments in 1956 and 1957 are given in table 2.

The treatment on the spring grain apparently had more influence on soil and water losses than the previous year's treatment on the corn. It is important, however, that the previous year's treatments influenced the current year's data.

TABLE 2.--Single plot data, showing influence of spring grain treatment on each corn treatment, and the effect of past treatment, LaCrosse, Wis., 1956-57

Treatment on corn, 1956	Runoff and soil loss							
	Treatments on grain, 1957						Effect of past treatment**	
	Plowed		Field cult.		FC & CS mulch*			
	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre
	Inches	*Tons*	*Inches*	*Tons*	*Inches*	*Tons*	*Inches*	*Tons*
Standard.....	0.44	4.40	0.10	0.12	0.02	0	0.19	1.51
Dead.....	0.44	3.97	0.04	0.06	0.02	0.03	0.17	1.35
Clipped.....	0.32	1.73	0.05	0.04	0.03	0.02	0.13	0.60
Unmowed.....	0.39	2.42	0.02	0	0.02	0.01	0.14	0.81
Average.....	0.40	3.13	0.05	0.06	0.02	0.02	0.16	1.07

*Field cultivator and corn stover mulch.
**Mean of 3 cultural treatments for spring grain.

These data would indicate that mulch consisting of corn stubble, hay, and weeds left on the surface by seedbed preparation with a field cultivator and these materials plus corn stover mulch may be expected to effectively reduce soil and water losses in this area.

Oklahoma

BARLEY AND OAT YIELDS AFFECTED BY STUBBLE-MULCHING

H. H. Finnell, Goodwell. --Grain yields of oats and barley tended to increase with increasing surface residue up to average quantities above which yields were lowered. This conclusion resulted from an analysis of data recorded on moisture studies from 1946-51 in the Great Plains area. The average yields of oats and barley after different degrees of stubble-mulch preparation are given in the accompanying table.

These crops are spring sown in all parts of the Great Plains, and the Northern, Central, and Southern regions have been delineated on the same basis as previously reported for the Northern Spring Wheat Region, Central Winter Wheat Region, and Southern Winter Wheat Region. The results for oats and barley were quite similar, excepting for geographic distribution. The oat crop was the more popular in the Northern Plains, with the frequency of fields declining toward the south. Barley was most popular in the Central Plains.

Oat and barley yields as affected by amount of stubble-mulching, Great Plains States, 1946-51

Area	Total number of fields	Average yield per acre by treatment*			
		A	B	C	D
		Bushels	*Bushels*	*Bushels*	*Bushels*
		Oats			
Northern	666	28.0	28.1	35.2	29.3
Central	545	22.1	22.2	24.4	25.6
Southern	291	19.2	15.9	16.5	17.5
		Barley			
Northern	484	20.2	21.6	24.1	21.4
Central	629	15.9	12.4	18.1	17.3
Southern	438	10.0	13.6	15.9	12.2

*Amount of residue on the surface at the end of the preparatory period: A, Little to none; B, Scant amount; C, Average amount; D, Excessive amount

Kansas

DEPTH, SPEED, AND DISK ANGLE AFFECT RESIDUE REMAINING

N. P. Woodruff and W. S. Chepil, Manhattan. --Recent studies of the tillage effects of the one-way disk show that the operational variables of speed of travel, depth of tillage, and angle of tillage have a marked influence on the placement of crop residues.

Results obtained after a single operation with a one-way disk on a wheat stubble field with an initial quantity of 2,000 pounds per acre of standing stubble are shown in tables 1 and 2.

TABLE 1.--Effects of different angles and speeds of one-way disk on stubble left on surface, Manhattan, Kan.

Angle*	Average speed per hour	Stubble left on surface
Degrees	*Miles*	*Percent of total*
43	2.5 or 3.6	51
43	4.6	37
50	2.5	29
50	3.6 or 4.6	14
53	2.5	15
53	3.6 or 4.6	25

*All angles are measured with respect to a line perpendicular to direction of travel. A 43-, 50-, and 53-degree angle setting corresponds respectively to the "soft", "med.", and "hard" ground setting marks found on the top of the implement frame near the land wheel. A constant depth of 4 inches was maintained.

TABLE 2.--Effects of different depths and speeds of one-way disk on stubble left on surface with a constant angle of 50 degrees maintained, Manhattan, Kan.

Depth*	Average speed per hour	Stubble left on surface
Inches	*Miles*	*Percent of total*
2	2.5	37
2	3.6 or 4.6	26
4	2.5	29
4	3.6 or 4.6	14
6	2.5	12
6	3.6 or 4.6	12

The data show that the maximum amount of straw residue maintained on the surface was 51 percent with 43-degree angle tillage accomplished at slow or intermediate speeds. Minimum amounts of 12 percent were left with 6.0-inch tillage.

Speed of travel has a variable effect on residue placement. In general, however, there is little difference between the effect of an intermediate (3.6 m.p.h.) and a fast (4.6 m.p.h.) speed. Slow speeds (2.5 m.p.h.), with the exception of 53-degree angle or 6.0-inch depth tillage, leave more residue on the surface than do fast or intermediate speeds.

Shallow tillage (2.0 inches) left more residue on the surface than did deep (6.0 inches) tillage.

Small angle (43 degrees) tillage left more residue on the surface than did large (53 degrees) angle tillage. However, the small angle was not as effective as the large angle for killing weeds which is a very important consideration and cannot be ignored in adjusting the implement.

The differences obtained in this study indicate the importance of correct one-way operational methods in maintaining surface residues for the prevention of wind erosion.

MOISTURE CONSERVATION

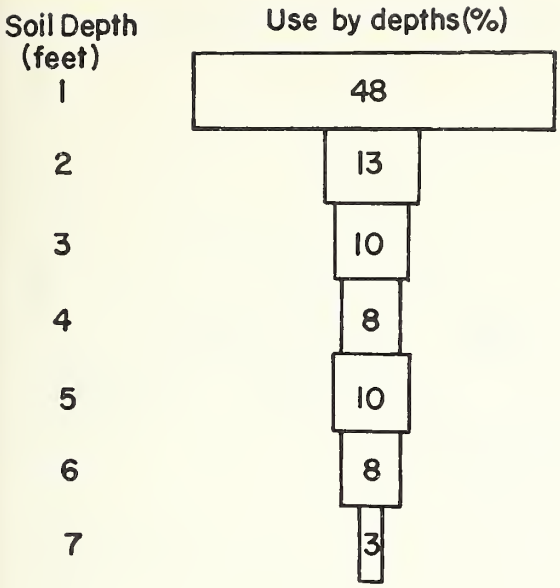
Kansas

WATER USE PATTERN MEASURED FOR DRYLAND GRAIN SORGHUM

Paul L. Brown, Hays.--Under dryland conditions, it is important to know the pattern of soil moisture use by crops. What percentage of the total water use does each soil zone or depth contribute?

In 1954 and 1955, a grain sorghum experiment was conducted on Tripp silt loam in which soil moisture use was determined. The average growing season rainfall, total consumptive water use, relative water use by different soil depths, and the grain yields for plots wet to a depth of seven feet at seeding time are shown in the accompanying figure.

Much of the consumptive water use was from the first foot. This was due to the fact that none of the rainfall penetrated below the surface foot. Not all this water was used by the sorghum crop, because evaporation removed an undetermined amount. Below the first foot, practically all of the water use was transpired by the crop. Water use differences from the second to sixth foot are considered insignificant.



Water use by grain sorghum from different soil depths. Average growing season rainfall was 5.89 inches, total consumptive use was 16.54 inches, and yield per acre was 42.8 bushels. Data are for 1954 and 1955 on Tripp silt loam, Hays, Kan.

The important thing to note is that grain sorghums use deeply stored moisture almost as completely as that near the surface. When the only source of water is this deep reserve, the crop is under considerable stress and will produce less than maximum yield. Disregarding the low water use from the seventh foot, the moisture use percentages by root zone thirds are as follows:

Upper third..... 61 percent
Middle third .... 18 percent
Lower third .... 18 percent

The lower two-thirds of the root zone contributed 36 percent of the total water use.

The root zone is frequently limited by the depth of moist soil, which varies greatly from year to year and location to location. The soil moisture content is normally greatest at seeding time and decreases as the season progresses. Except for the surface foot, the root zone is normally not rewet during the growing season. The reason for this is that water use exceeds precipitation.

The two years involved in this study were dry years, with only about one-half average rainfall. Therefore, the percentage figure for the surface soil is near the minimum to be expected and the figures for the lower depths are near maximum. This assumes that the growing-season rainfall does not penetrate below the one-foot depth. There are occasional years that are exceptions to this assumption.

North Carolina

RADIATION INTENSITY DETERMINES WATER USE BY BERMUDAGRASS

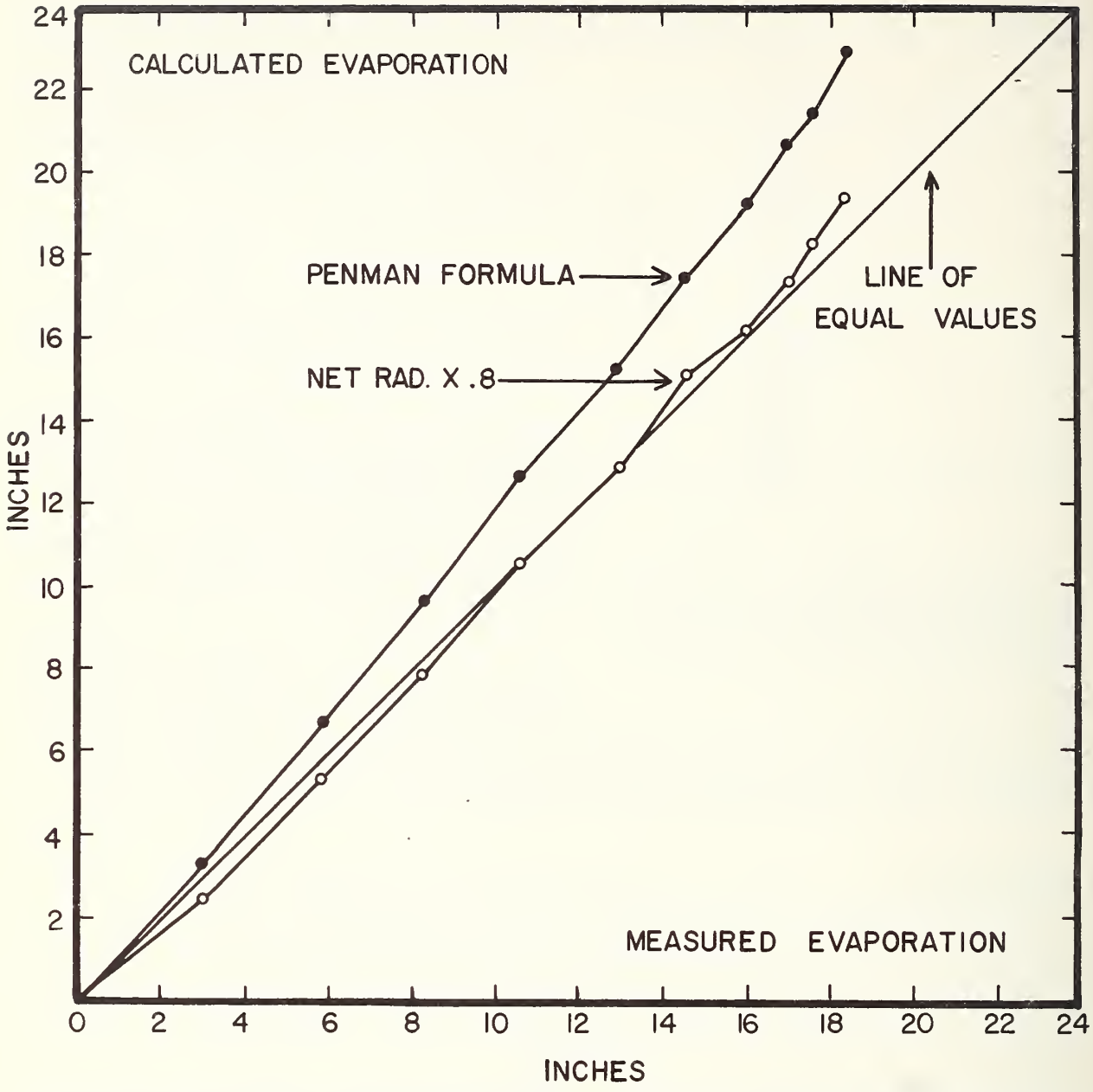
C. H. M. van Bavel and D. G. Harris, Raleigh.--When soil and plant factors are not limiting, water use by Bermudagrass can be explained almost exclusively upon the basis of the radiant energy received at the surface. Other factors, such as air temperature, relative humidity, and wind velocity appear to have an insignificant effect upon evapotranspiration.

Measurements of maximum water use by common Bermudagrass were made during the second half of 1956 in an installation consisting of three 22-inch evapotranspirometers. These were in the middle of a 100 x 100 foot plot which was kept irrigated throughout the period.

Measurements were made of net radiation (energy gain by the surface), of air temperature and humidity, and of wind velocity.

Evapotranspiration was calculated in two ways: by using the Penman formula which gives due consideration to all meteorological factors, and by simply assigning 80 percent of the net radiation to evapotranspiration. The value of 80 percent is suggested by studies other than the present one.

There were 31 periods during 1957 for which measured and computed values could be compared. They were grouped in 10 bimonthly periods as shown in the accompanying table.



Accumulated evaporation from Bermudagrass for the period June 15 to Nov. 21, 1956, compared with calculated values, Raleigh, N. C.

For the 31 periods of measurement a correlation of 0.90 was obtained between measured values and those calculated with the Penman formula. The correlation between measured values and those calculated directly from net radiation was 0.88. This indicates that the added complications of the Penman formula do not result in better estimates. Furthermore, the absolute values obtained from net radiation agree better with the measured ones than do the results of the Penman calculation. This is evident from the accompanying figure.

Direct use of net radiation data has the advantage of simplicity and it avoids several assumptions needed in using the Penman formula.

Measured and calculated evapotranspiration from Bermudagrass
Raleigh, N. C., 1957

Period	Daily evapotranspiration		
	Measured	Calculated from Penman Formula	Calculated from net radiation
	Inches	*Inches*	*Inches*
6/15-6/30	0.220	0.223	0.185
7/1-7/15	.185	.232	.185
7/16-7/31	.152	.183	.161
8/1-8/15	.155	.202	.179
8/15-8/31	.139	.161	.139
9/1-9/15	.111	.146	.129
9/15-9/30	.102	.109	.085
10/1-10/15	.064	.110	.091
10/16-10/31	.040	.047	.051
11/1-11/21	.037	.069	.054

Investigations are continuing with other crops at Raleigh to verify the findings made to date. Also, studies are being conducted to correlate net radiation data with measurements of sunshine duration and of total radiation. Observations on sunshine duration and total radiation are being made at many locations.

TILLAGE AND CULTURAL PRACTICES

Arizona

COTTON YIELD INCREASED WITH MINIMUM SEEDBED PREPARATION

Leonard J. Erie and Karl Harris, Phoenix. --Minimum seedbed preparation involving plowing, irrigating, and harrowing for cotton outyielded other more elaborate preparation operations from 145 to 260 pounds of lint cotton per acre. Moreover, from $3 to $15 per acre were saved in labor, equipment operation, and irrigation water costs by the minimum treatment.

The results reported are from the third year of acala 44 cotton in a rotation of alfalfa - barley, 2 years - cotton, 4 years on the Mesa Experimental Farm of the University of Arizona.

The seedbed preparation treatments used and the yields of cotton were:

Seedbed preparation	Yield of lint per acre
	Pounds
Plow, irrigate, harrow	1,740
Plow, disk, drag, irrigate, disk	1,480
Plow, disk, irrigate	1,540
Plow, irrigate, disk	1,595
Plow, irrigate, disk, irrigate, disk	1,558

Summary:

1. The greater yield of lint cotton from plots receiving minimum seedbed preparations over each of the other treatments is significant at the 5 percent level.

2. Yield differences among the remaining treatments are not significant.

3. As indicated, the greater yield from minimum seedbed preparation was produced at a considerable saving in labor, equipment operation, and irrigation water cost.

SOIL AND WATER MANAGEMENT-GENERAL

Georgia

AIR-DRIVEN SOIL TUBE SPEEDS DEEP MOISTURE SAMPLING

J. R. Stansell and George Sparrow, Tifton.--A soil tube which is driven by a compressed-air hammer is proving to be a fast, efficient tool for taking soil moisture samples to a depth of four feet in soils at the Georgia Coastal Plain Experiment Station.

Figure 1.--Air-driven soil sampling device. Shown are the driving surface, driving head, and air hammer with driving tool, Tifton, Ga.

The essential elements of equipment for such sampling are (1) a soil tube of suitable length; (2) a detachable driving head; (3) a light pneumatic hammer, with the stub of a cutting or chipping tool; and (4) a portable compressed air supply, with sufficient hose to reach into plots to be sampled.

The soil tube is similar in principle to the Veihmyer tube. Figure 1 illustrates the driving surface of steel pipe which has been brazed to the soil tube; the driving head which transmits the impact to the driving surface; and which has a recess for inserting the driving tool; and the driving tool in the air hammer.

The commercially produced air hammer is light, weighing about 4.25 pounds but provides ample impact for driving the tube. Samples are being taken satisfactorily in Tifton loamy sand to a depth of 4 feet. The surface soil is loamy sand with a sprinkling of pebbles, graduating into a heavy type of sandy loam subsoil and sandy clay parent material. A trailer-mounted, jeep-towed, gasoline-powered air compressor supplies air to the hammer at about 90 pounds per square inch pressure.

Figure 2.--Taking soil samples with air-driven soil sampler, Tifton Ga.

Figure 2 shows the sampling device in operation, with

the compressor unit in the background. It was thought earlier that the tube could be driven its entire length, extracted, and the soil core taken out for cutting into desired sampling increments. That procedure caused difficulty of tube removal and doubt as to proper increment division. Under present procedure the tube is driven to the depth of the first required sampling, removed, and the sample so taken discharged into the sampling can by tilting the tube toward its upper end. The tube is then carefully replaced in the hole created by the first sampling and driven to the next depth. By discarding loose soil which comes out with subsequent samples, quite accurate moisture samples are obtained.

Experience with the sampler indicates that sampling can be accomplished in 6-inch increments to depths of 4 feet in about 10 minutes including the time of transporting the unit from one plot to another.

Colorado

RESEARCH INCREASED EFFICIENCY OF MOUNTAIN MEADOWS

Forrest M. Willhite, Hayden K. Rouse, Eugene Siemer, and Albert Grable, Gunnison. --For seven years, 1949-1957, the mountain meadow research program in Colorado, conducted cooperatively among local, State, and Federal groups, has attempted to find ways and means of increasing the yield and quality of forage as a means to more efficient beef production. Some 40 to 50 publications have been released during the period these studies have been under way.

From the basic research carried on in many sections of the State on the effect of water control, fertilization, harvest management, and kind of crop grown and from the applied research in conjunction with the Rancher Research Corporations certain broad conclusions are available.

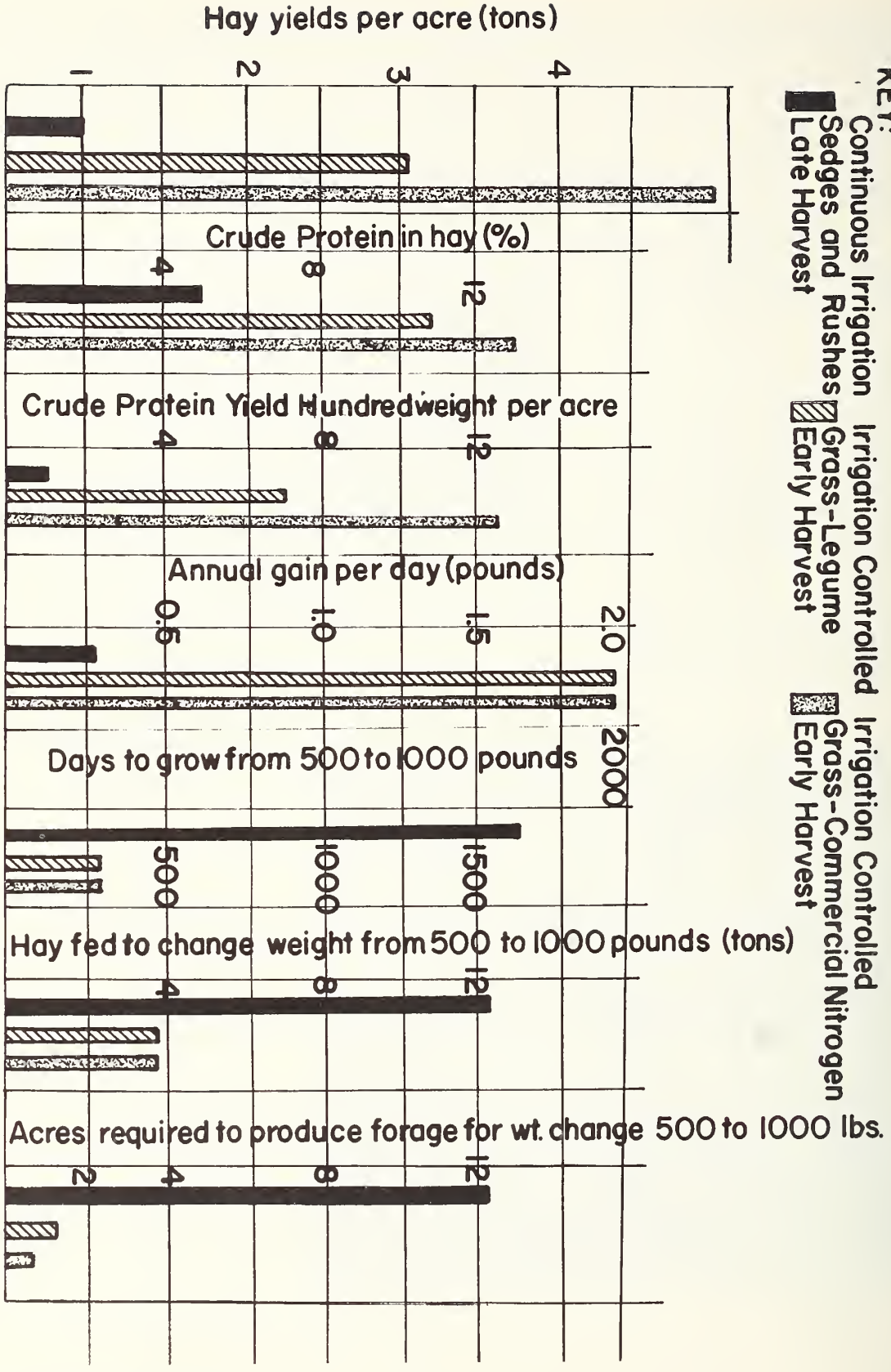
1. Irrigation change from continuous, uncontrolled, to intermittent controlled, will change the sward from a wire grass forage yielding one ton of hay per acre to a tame grass-legume forage yielding 3.5 tons per acre.

2. Intermittent irrigation on a tame grass-legume meadow liberally treated with commercial nitrogen will eliminate the legumes, and increase the yield to 5.5 tons per acre.

3. Harvest management will improve the quality of the forage as noted by crude protein content of 5.0 percent in late cut forage compared with 11 percent in early cut hay.

4. Grade 500-pound heifers when offered all they will eat (about 12 pounds per day) will gain approximately 0.2 pounds daily on 5 percent hay; approximately 1.1 pounds daily on 9.5 percent hay. Purebred heifers will gain approximately 2.0 pounds daily on 12.5 percent hay.

When these four observations are combined as an expression of yield of forage and of beef the following relative efficiencies become apparent. The figures show that as irrigation and harvest management are improved the yield and quality of the mountain meadow hays are greatly improved. The overall efficiency of beef production is increased many fold as reflected in the acres required to produce 500 pounds of beef. When management is poor, 12.5 acres are required. When management is good with legumes, 0.65 acres are required, and with commercial nitrogen 0.4 acres are required.



Effect of irrigation control, fertilization, harvest date, and type of forage on the yield and quality of hay and the feeding value as measured by livestock performance, Gunnison, Colorado.

Texas

CONSERVATION FARMING WAS PROFITABLE IN 1955 AND 1956

R. M. Smith, Temple.--An experiment has been under way at the Blackland Experiment Station near Temple since 1955, objectives of which are to determine the combined effects of good soil, water, crop, and livestock management practices on farm production and to determine effective means of fitting or integrating new methods for soil, water, crop, and livestock management into farming systems. The work is being conducted cooperatively with the Texas Agricultural Experiment Station, the Farm Economics Research Division of ARS, and the Soil Conservation Service.

Detailed analyses of 1955 and 1956 data from this experiment have been developed by Ralph Rogers, Agricultural Economist, Agricultural Research Service, College Station. A total of about 345 acres is involved in the operations under study, with 279 acres of cropland, 64 acres of permanent grassland and 2 acres allocated as a normal area for farm buildings. Twenty-six acres of the cropland were used for cotton in 1955 and 49 acres in 1956. Cotton returned 39 percent of the net farm income in 1955 and 52 percent in 1956. The remaining cropland was used for corn, grain sorghum, barley with sweetclover, and oats with sweetclover. Some hay was grown on other land and was charged against the livestock at prevailing prices.

Summaries by Mr. Rogers are as follows: Net income from crops amounted to $3,559 in 1955 and $2,889 in 1956. Livestock netted $1,788 in 1955 and $1,205 in 1956. From the market value of production, all cash costs were subtracted, as well as labor charges and interest and depreciation on buildings and equipment. The hours of labor and the amount and value of both buildings and equipment were modified to reflect usual farm situations rather than the requirements of an experiment station. The total net incomes of $5,347 and $4,094 in 1955 and 1956 respectively, represent a return to management, including risk-taking, which a farmer might refer to as "profit" above all costs, including his own labor at the going rate of 50 cents an hour.

Actually, this analysis covers more than the calendar years 1955 and 1956. Relative to the 1955 data, 63 steers were purchased July 2, 1954; 14 on August 26, 1954; and 25 on September 2, 1954. Concerning 1956 livestock data, 50 calves were purchased on July 8, 1955, and 56 on August 25, 1955. An average feed cost of $20 per head in 1954-55 and $10 per head in 1955-56 from date of purchase to the time the steers were put in the drylot includes the cost of cake, grain, and hay fed during the entire period. Interest at 6 percent was charged against the average investment in livestock for the periods during which the steers were grazed, as well as for the 145 days in 1955 and 98 days in 1956 they were in the drylot.

Livestock gains on pasture--grass, small grain, aftermath, etc.--amounted to 33,800 pounds at a feed cost of 6.9 cents per pound in 1955 and 25,133 pounds at a feed cost of 12.9 cents per pound in 1956. Total gain of 36,800 pounds in 1954-55 and 35,400 pounds in 1955-56 between purchased weights and weights when cattle were put in the feedlot, cost 11.8 and 12.1 cents a pound, respectively, for feed and pasture. Livestock returned 33.4 percent of the total net farm income in 1955 and 29 percent in 1956.

Data for the study are summarized in tables 1 and 2.

TABLE 1.--Land use on "Farm" used in study of conservation farming, Temple, Tex., 1955-56

Item	1955	1956
	Acres	*Acres*
Acres in "Farm"	350.1	345.3
Cultivated cropland	282.6	279.1
Permanent grassland	65.5	64.2
Farmstead, lanes, etc	2.0	2.0
Cropland use:		
Corn	27.5	25.2
Grain sorghum	26.0	29.4
Cotton	26.2	49.0
Small grain - clover	170.9	151.5
Sudan	29.0	24.0
Idle*	3.0	--
Total	282.6	279.1

*3 acres from plot area refenced for inclusion in "the farm."

TABLE 2.--Livestock enterprise data from "Farm" used in study of conservation farming, Temple, Tex., 1955-56

Item	1955	1956
Livestock sales	100 head, 103,800 lbs. @ 21¢ $21,798.00	104 head, 99,112 lbs. @ 22.6¢ $22,360.00
Livestock purchases	102 head, 43,860 lbs. @ 18¢ $7,894.80	106 head, 47,488 lbs. @ 22.1¢ $10,494.00
Sales, minus purchases	$13,903.20	$11,866.00
Production costs:*		
Grazing period	$5,552.00	$5,474.77
Feedlot period	6,563.04	5,185.73
Total	$12,115.04	$10,660.50
Profit from enterprise	$1,788.16	$1,205.50

*Includes interest on livestock investment, labor, veterinary and medicines, concentrates, grain, hay, and cost of growing grazing crops with credit allowed for manure.

HYDROLOGY-GENERAL

Ohio

JUNE FLOODS HIGHEST ON RECORD

L. L. Harrold and D. L. Brakensiek, Coshocton.--Rainfall in June 1957 on areas of 29 to 4,581 acres produced flood peaks that surpassed most of those recorded at this

Station in 20 years. The storm of June 12 centered over the Station with a maximum depth of 3.53 inches. Over the adjoining Little Mill Creek watershed of 4,581 acres, the rainfall ranged from 1.6 to 3.2 inches. The June 28 storm centered over the Little Mill Creek watershed with a maximum of 3.13 inches. Over the Station, this rain totaled from 2.7 to 2.9 inches.

The accompanying figure shows the time distribution of these two storms and table 1 gives flood peaks on a range of watershed sizes. Although the June 28 storm had less volume and was distributed over a longer period, it produced much greater flood flows on the larger watersheds than that of June 12. Maximum flood rate previously recorded on these watersheds are also given in table 1.

Maximum rainfall rates for different time periods from 2 to 60 minutes are given in table 2. As indicated in table 2, the rainfall rates for the June 12 storm were exceedingly high. Intensities for the 30- and 60-minute periods were greater than the 100-year values for this location. Rainfall rates for the June 28 storm were considerably less.

Antecedent soil moisture was an important factor in causing the greater flood peaks from the storm of June 28. Data in table 3 show that 1.53 inches of rain fell in 17 days prior to the June 12 storm, whereas the June 28 storm was preceded by 6.65 inches in 17 days.

Normal tillage conservation practices appeared to provide no noticeable protection to the land for water control in the intense storm of June 12. Flood peaks on the conservation corn watersheds ranged from 4 to nearly 6 inches per hour. That on the check area was 4.12 inches per hour. The minimum tillage, on plow-plant conservation watershed produced a flood peak of 3.12 inches per hour, or from 1 to 3 inches per hour less than the normal-tillage conservation watersheds.

TABLE 1.--Flood rates for June storms, Coshocton Research Station watersheds, 1957

Watershed No.	Areas	Previous high flood peaks	Flood peak	
			June 12	June 28
	Acres	*cfs*	*cfs*	*cfs*
169	29.0	70.1	75.8	40.8
183	74.2	193	187	97.5
177	75.6	156	240	89.8
10	122	212	40.5	175
11	292	121	87.8	268
91	293	186	175	398
196	303	580	1,140	512
5	349	237	152	382
92	920	446	262	578
94	1,517	674	669	1,400
95	2,569	936	894	1,590
97	4,581	1,060	909	3,340

Note: See Table No. 2 for maximum rainfall intensities.
Watersheds 169, 177, 183, and 196 served by rain gage No. 102.
Watersheds 5, 10, 11, 91, 92, 94, 95, 97 served by rain gages Nos. 27 and 39.

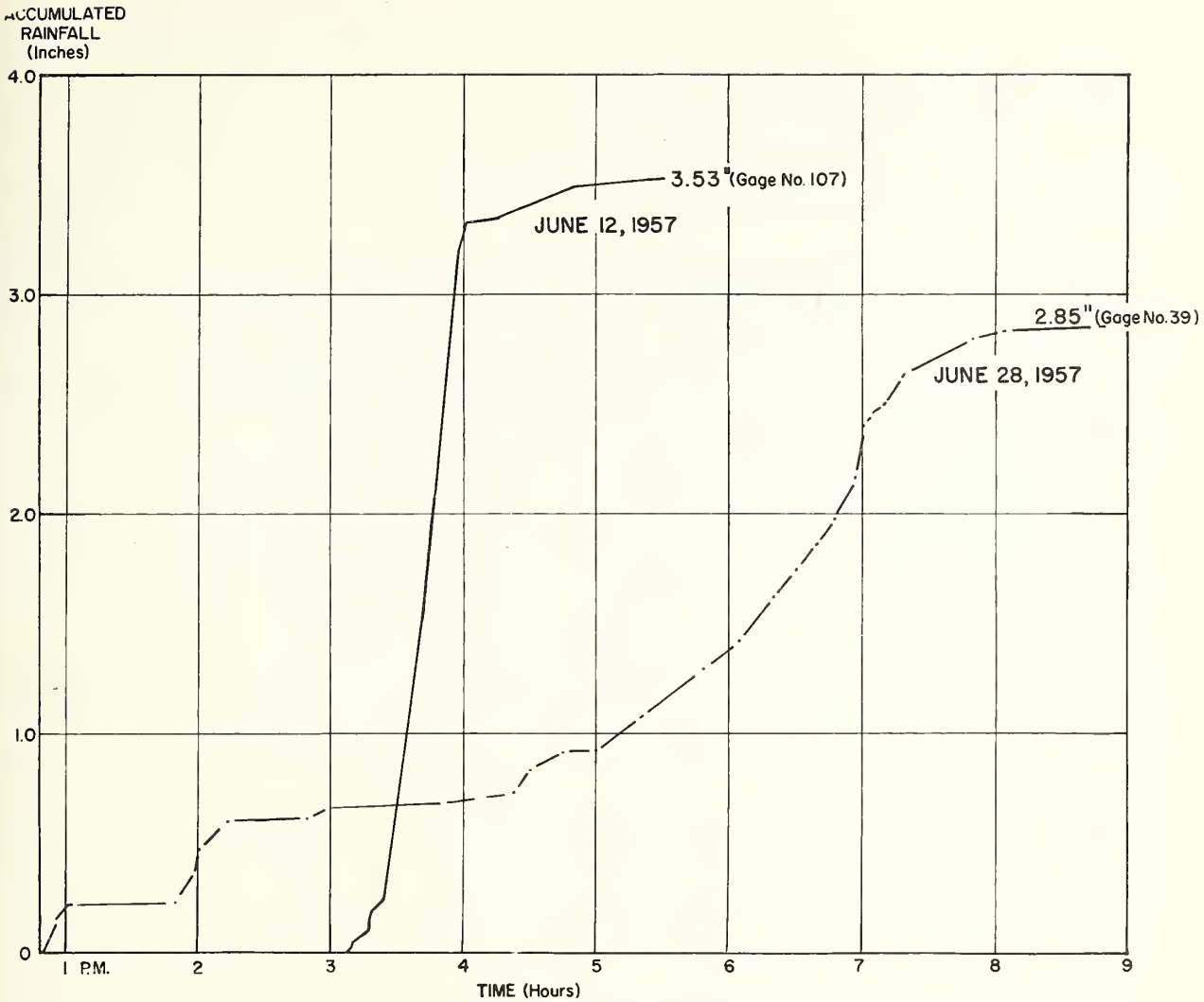
TABLE 2.--Maximum rainfall intensities for storms of June 12 and 28, Coshocton Research Station Watersheds, 1957

Period	June 12, 1957				June 28, 1957			
	Gage 102		Gage 27		Gage 102		Gage 39	
	Rate	Freq.	Rate	Freq.	Rate	Freq.	Rate	Freq.
Min.	*In/Hr.*	*Years*	*In/Hr.*	*Years*	*In/Hr.*	*Years*	*In/Hr.*	*Years*
2.....	7.50	--	6.00	--	5.10	--	3.75	--
3.....	6.80	--	5.80	--	4.40	--	3.75	--
5.....	6.16	15	5.08	4	2.82	< 2	3.23	< 2
10.....	5.70	25	4.42	5	2.48	< 2	2.18	< 2
15.....	5.69	75	4.40	15	2.12	< 2	1.82	< 2
30.....	5.25	> 100	3.14	15	1.43	< 2	1.33	< 2
60.....	3.22	> 100	2.12	25	1.08	2	1.04	2

Note: Total storm rainfall at Gage No. 102 = 3.44" June 12
Total storm rainfall at Gage No. 27 = 2.89" June 12
Total storm rainfall at Gage No. 102 = 2.78" June 28
Total storm rainfall at Gage No. 39 = 2.85" June 28

TABLE 3.--Rainfall prior to storms of June 12 and June 28, at Gage No. 102, Coshocton Research Station Watersheds, 1957

Days prior to storm	June 12	June 28
	Inches	*Inches*
0.....	0	0.17
1.....	.29	0
2.....	0	0
3.....	0	0
4.....	.95	2.11
5.....	0	.08
6.....	0	0
7.....	0	0
8.....	0	0
9.....	0	.02
10.....	0	0
11.....	.12	0
12.....	0	0
13.....	0	.04
14.....	0	.08
15.....	0	.42
16.....	0	3.44
17.....	.17	.29
Total.....	1.53	6.65



Time accumulation of rainfall for June 12 (Gage 107) and June 28 (Gage 39), Coshocton Research Station, Ohio, 1957

Michigan

SOIL MOISTURE INSTALLATIONS REJUVENATED

Nina C. Cottom, East Lansing.--In May of 1957, new nylon moisture blocks were installed at the wooded watershed. The leads to the blocks which were installed in 1953 were in very poor condition, and in order to obtain correct readings, new blocks were installed in the same soil types and at the same depths as the original blocks. Calibration curves have now been completed for each soil sample at each depth used in the study. The gravimetric sampling at approximately the same location, which was started during the first quarter of 1957 in conjunction with research for a Ph. D thesis in forest hydrology, is being continued until late September 1957, and the readings will be correlated with the readings obtained from the blocks.

In connection with the soil moisture studies, 3 x 3 soil cores are being taken in order to determine certain physical properties of the soils found on the watershed; namely, permeability, porosity, and bulk density.

Texas

RECORD RUNOFF MEASURED FOR 25-DAY PERIOD

M. A. Hartman and R. W. Baird, Riesel.--More rainfall and more total runoff were recorded during the period April 19 to May 13, 1957, than in any other 25-day period since the work was established at Riesel in 1937. However, these rains did not cause maximum volumes of runoff for periods from 1 hour to 8 days. Only the 25-day total runoff established a record high.

In the accompanying table maximum amounts of runoff from a 176-acre watershed during this period are compared with those produced during a storm period in 1944. This watershed has had straight-row cultivation and a large percent is in row crops.

The 1957 peak rate was exceeded in May 1944 and also in July of 1941. The 1957 runoff volumes for all time periods listed except the 25-day period were exceeded in 1944. The 1957 2-day amount was also exceeded in November 1940.

Maximum runoff for 176-acre watershed, Riesel, Texas, 1944 and 1957

Maximum amounts of runoff for different time periods	1957 April-May	1944 April-May
	Inches	*Inches*
1 hour	2.22	2.99
2 hours	2.68	5.57
6 hours	3.42	6.91
12 hours	3.50	6.92
24 hours	3.51	7.05
48 hours	5.14	9.20
192 hours	9.30	11.06
25 days	15.51	11.22
Peak rate (inches/hour)	2.87	4.51

Rainfall intensities for periods as great as one hour generally did not exceed the once-in-10-years intensity. The length of the storm period and the total amount of rainfall were factors contributing to the damage and flood conditions general throughout the area. Local areas in the vicinity did have much greater rainfall and much higher intensities, but very few raingages were located in these areas.

During this storm period, the effect of land use and other conservation practices was at a minimum. The only treatment which appeared to have appreciable effect upon the amount of runoff was terracing with heavy growth of oats and clover. Peak rates of runoff were reduced by terrace systems or heavy vegetal growth.

HYDROLOGY--LAND USE INFLUENCES

Nebraska

COOPERATIVE WATER YIELD PROCEDURES STUDY STARTED

A. L. Sharp, Lincoln.--Announcement is made of the initiation of a cooperative water yield procedures study at Lincoln, Nebraska. The study is being undertaken by the Agricultural Research Service, the Soil Conservation Service, and the Bureau of Reclamation.

The primary purpose of the work contemplated is to develop and test procedures for evaluating the effects of watershed treatments on the yield of streamflow from watersheds ranging in size from the very small upstream area to major river basins. Data may be drawn from all available sources, but emphasis will be placed on application of the results in those areas where streamflow is deficient.

HYDRAULICS

Illinois

COOPERATIVE STUDIES INITIATED ON DROP INLETS

William C. Ackermann and Harold W. Humphreys, Illinois State Water Survey, Urbana.--Generalized research on drop inlet structures is being performed by the Illinois State Water Survey in cooperation with the Agricultural Research Service, the Soil Conservation Service, and the Illinois Agricultural Experiment Station. Ideas and technical advice are exchanged between the experienced personnel of these agencies through correspondence and visits. Very close cooperation is maintained between the Agricultural Research Service staff at St. Anthony Falls Hydraulic Laboratory and the Illinois State Water Survey staff at Urbana, Illinois. The project objectives are to determine the most desirable proportions and shapes of drop inlet structures with deep approach channels that have unique flow characteristics, to develop antivortex devices, and to keep practical construction techniques in mind.

Representatives of the cooperating agencies initiated this joint effort early in February 1957. At present the experimental apparatus is being assembled prior to testing.

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